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EVALUATION OF FIVE FOOD-RATING-FEEDBACK CARDS: FINAL REPORT

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Food Sciences Laboratory

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Five food-rating cards, designed for the purpose of evaluating single food items, were compared in tests at Fort Lee, Virginia, and Natick Research & Development Command, Natick, Massachusetts. Statistical analyses showed one of the cards to be superior in design. This card contained four rating categories of food attributes — Temperature, Flavor, Portion Size, and Texture — each of which had a seven-point rating scale. Future work in the administration of this rating card was recommended.

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PREFACE

The design and pilot testing of the original food-rating-feedback card was performed by Dr. Terence R. Dockerty and Colonel Thomas E. Florine of the U. S. Army Troop Support Agency, Fort Lee, VA. They should be commended for their initiative in tackling such a complex and worthy task. The authors would like to thank them for their assistance in data interpretation and their support of the testing of the new feedback cards presented in this document. Deborah Hunt of the U. S. Army Natick Research and Development Command deserves our thanks for her assistance in the analysis of the initial Fort Lee data.
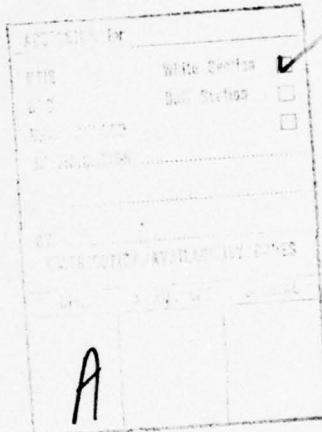
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EVALUATION OF FIVE FOOD--RATING--FEEDBACK CARDS:

FINAL REPORT

INTRODUCTION

The purpose of this report is to present an evaluation of a food acceptance rating card for use in military dining halls. In a series of studies of consumers' opinions of military food service, consumers have stated that their most serious complaint concerns food quality (Jacobs and Meiselman, 1976)[1]. Thus, the key issue in improving military food is to **improve the food**. This requires food service system planners and managers to be knowledgeable about the quality of their product. There are two general approaches to obtaining this type of information: one is to utilize professional or semiprofessional staff to inspect food; another is to depend on feedback from customers about the food. A combination of approaches is probably the best answer. Ideally, feedback from customers should be obtained in an economical manner, and in a manner which avoids possible bias on the part of those collecting the data. Circumventing the dining facility management in the collection process would help to insure the elmination of bias. A feedback card which can be self-administered by customers is ideal from the practical viewpoint. Therefore, if it can be shown to be a good measure of opinion, the feedback card could have an important place in military food service.

Members of the Behavioral Sciences Division, Food Sciences Laboratory of the U.S. Army Natick Research & Development Command (NARADCOM) were approached informally by personnel of the Food Service Directorate, U.S. Army Troop Support Agency (USATSA) to aid in evaluating a new consumer food preference rating card designed by USATSA. This card (Appendix A, Figure A—1) utilizes 3 behavior/attitude questions followed by eight rating scales. This inquiry was followed by a formal Customer Order for Technical Work (#606), dated 4 February 1975, and a transfer of funds to NARADCOM. The original request entailed analysis of rating card data which had been collected by USATSA in dining facilities at Fort Lee. These data included eight different food items. Following initial testing, data from three foods (grilled steak, mashed potatoes, and cereal) were selected for a more thorough evaluation. These foods were chosen for two reasons: they had relatively large numbers of subjects responding, and they represented the spectrum of foods tested. The questions being addressed by these analyses follow:

[1] Jacobs, H. L. and H. L. Meiselman. Customer morale and behavioral effectiveness: Accomplishments and goals of psychological studies of food service systems. In Proceedings, Third International Meeting, Foods for the Armed Forces. NARADCOM Technical Report 76—42—OTD. March, 1976.

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1. Are the answers to the questions of "selection", "past liking", or "customary use of the dining facility" (see Appendix A, Figure A—1) correlated with ratings from the eight food attributes?

2. Do the ratings differ systematically by the questions "selection" or "past liking"?

3. Are the eight ratings of food attributes different from each other, or is there overlap between them?

4. Are adjacent ratings (i.e., adjacent columns on the card) more alike than non-adjacent ratings?

Further analysis of the USATSA data was suggested to determine if it would be statistically and experimentally sound to pool sample populations from different posts to achieve an "Army mean". Data collected by USATSA at Forts Hood, Carson, and Campbell were selected for this analysis because of their high response rate and wide geographical distribution.

Following a discussion of the initial analysis, it was determined that NARADCOM should develop several alternative forms of preference rating cards, the performance of which could be compared with that of the USATSA card. The purpose of the alternative cards was to answer the following specific questions:

1. Can the overlap found in the responses to the eight categories on the USATSA card be reduced by:

    a) fewer number of categories?
    b) different physical presentation?
    c) different verbal anchors for the scale points?
    d) introduction of an additional question asking overall preference?

2. Would a reduction in the number of categories leave out critical information, thus hampering the investigation?

3. Are the behavior/attitude questions on the USATSA card necessary? (Do you normally like this item? Do you like to eat here often?)

4. Is there a difference in transmitted information (i.e., sensitivity) when using the seven-point scale versus the five-point scale.

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The testing of these new style cards took place at NARADCOM and Ft. Lee. After studying the initial returns, it was decided that two additional questions should be posed:

1. Can any or all of the card forms detect intention adulteration of a food (e.g., reduced portion size or different grades of beef) and thereby provide a measure of validity?

2. Is there a difference in the preference ratings obtained from cards voluntarily handed in by subjects versus those cards picked up from the tables by the experimenter at the end of the meal?

Because the development of a consumer feedback card is of interest to NARADCOM, a portion of the additional investigation was funded by NARADCOM under project 1Y762724AH99 (Food Technology), Task BF (Human Factors Studies on Military Feeding Systems), Work Unit 003 (Flavor Measurement and Acceptance Methodology). The remainder of the work, including testing of the various new card forms, was performed under Army Requirement 4–2, "Support of the Modern Army Food Service System".

SYNOPSIS: *The purpose of this investigation was to study the statistical properties of responses to the feedback card developed by USATSA and compare these with responses to alternative card forms developed by NARADCOM. A key test was to determine whether any or all cards would reflect intentional adulteration of a food.*

METHOD

The major portion of this investigation centers around the collection of food acceptance data using a 3" x 8" or 5" x 8" rating card. Although there were multiple administrations of this survey at different times of the year and day, or at different physical locations, it is possible to describe the general procedure of data collection for all cases at one time.

Respondents: The respondents were primarily enlisted personnel below the rank of E–5. Most were males between the ages of 18 and 21. The schools at Ft. Lee did have some senior NCO's, however.

Location: Surveying took place in Class A dining facilities, both short order and regular menu lines. Several of these facilities were of the consolidated type.

Food Selection and Preparation: The foods surveyed were generally selected on the occasion of their appearance in the 42 day Master Menu. An exception was made in several cases in order to collect data on the same food on consecutive days. The preparation of foods used standard procedures in accordance with the Army Forces Recipe Cards customarily used by all dining facilities. The exception involving white cake will be discussed later.

Procedure: Signs were posted on the outer doors to the dining facility announcing the test food. The "headcount" was requested to hand survey cards to the first one hundred willing participants as the individuals signed in at the desk. In one session the "headcount" was asked to hand-out 200 cards because a large number of respondents was critical for adequate statistical analysis. The food being evaluated (only one per meal) was available on the serving line as it would have been at any other time. No attempt was made to entice the subjects to select it. At times, however, the test food was the only one of its class available. This happened by chance when the alternate choice was depleted, or intentionally when the experimenter wished to better the chances of getting a large response to the food items. At the end of the serving line or near the dish bussing line, a sign identified a receptacle where the participant was to voluntarily return the card after his meal. The instructions on the cards varied in their length and detail (See Appendix A). On several occasions, cards were retrieved from the table tops following the meal. These cards were analyzed separately.

RESULTS AND DISCUSSION

Original USATSA Data

These data, collected in six dining facilities at Fort Lee, evaluated eight food items. The foods which were served at the noon and evening meals were testing using the USATSA-designed rating card (See Appendix A, Figure A–1). Data from three foods (grilled steak, mashed potatoes, and cereal) were selected for in-depth analyses, including analysis of variance (ANOVA) and discriminant analysis.

The three behavior/attitude questions on the card were the initial point of focus in this investigation. These questions were: "Did you select _____? Do you normally like this item? and Do you like to eat here often?" Although persons who had indicated they had not selected the food item were instructed not to complete the rating card, many did. The ratings given by non-selectors, however, were not statistically different from those given by selectors. It is unclear whether those who stated they had not selected the food: (a) were correct in stating they had not selected it, and (b) were responding to a previous memory of the food in the dining hall, at home, or at a commercial facility, or (c) were using informative supplied by someone else. Nevertheless, the feedback card must be viewed as a response to an item as it is served on a particular day. The card forms designed later by NARADCOM changed the format to try to eliminate the inappropriate responses. The lengthy instructions on Card #1 were omitted (See Appendix A). The selection question simple read:

Did you select _____?   ☐ Yes (continue answering)
☐ No (STOP & Return card)

This question was separated from the rest of the card by a bold line.

The second behavior/attitude question, "Do you normally like this item?" was shown by discriminant analysis to be the best predictor of whether or not the subject selected the item. There was also a significant difference between the ratings of "likers" and "non-likers". It is not surprising to discover that people who do not normally like the food, reflect that opinion in the ratings of the food, assuming the food and preparation methods are constant. Nonetheless, it is our opinion that **anyone** who has selected the food (and presumably eaten some or all of it) is entitled to an opinion about it. Therefore, elimination of this question is advised for simplicity's sake.

The discriminant analysis uncovered a strong relationship between the third question, "Do you like to eat here often?", and the eight evaluative questions (good/bad). This relationship indicated that rating of a food was not independent of the degree of liking of the dining facility, i.e., people who disliked the dining facility, also disliked the food, possibly independent of the food quality. Since one cannot easily resolve whether people dislike the dining facility because of the food, or the food because of the dining facility because of the food, or the food because of the dining facility, or dislike both because of a third factor, it was decided to delete this question from the form developed by NARADCOM.

The eight ratings of food attributes were found to be significantly correlated (Pearson r).* This finding suggests that although the categories are logically dissimilar (e.g., texture vs. portion size), the subjects are not responding to them independently. They are responding with a bias which does not reflect a true multiattribute evaluation of the food. They may be responding on the basis of a previously held, generalized attitude (halo effect), or they may be attending to one or two specific attributes and allowing those ratings to influence (carry over to) the others (also a halo effect). This can occur especially if there are too many attributes to be evaluated and the rater has difficulty separating them. Another possibility is that the raters were responding without attention to the card at all (blindly) using a position response bias (straight lining), or there could have been some unkown systematic bias resulting from an interaction between rator error and scale complexity. Based on the above-mentioned results and the state of the art of scaling technology, the authors felt the reducing the number of scaled attributes would be wise. Reducing the number of food qualities to be rated from eight to four, thereby simplifying the task, was expected to encourage the subjects to respond differentially across the food qualities.

*Cereal: $\bar{x} = + .068$, SD = .07, range = .57 — .81
 Mashed Potatoes: $\bar{x} = + 0.58$, SD = .08, range = .37 — .72
 Grilled Steak: $\bar{x} = + 0.58$, SD = .08, range = .42 — .74

The analysis of adjacent versus non-adjacent ratings in the eight columns was undertaken to determine if answers to neighboring food quality categories influenced one another. There was no significant difference between adjacent and non-adjacent ratings. This would be expected if the subject 'straight-lined'; i.e., gave all columns the same rating (from good to bad). This hypothesis also accounts for the high correlations among scales reported immediately above. To avoid this type of position-response bias on the NARADCOM card forms, the scales were designed so that a positive or negative answer was not physically in the same location on all four food attribute categories. To further encourage independence in the rating process, the categories were separated physically and enclosed in a 'box', vis-a-vis the continuous format used in the USATSA form.

SYNOPSIS: Initial analysis of Card 1 data suggested elimination of two behavior/attitude questions and redesign of the question asking whether the respondent had selected the item. Analysis of the eight response scales suggested that fewer scales of a different design might perform better.

Forts Campbell, Hood, and Carson Data

These data were collected by USATSA using the original rating card. The participating dining facilities were sent one hundred rating cards and were asked to distribute them to volunteers, collect the cards which were returned by the subjects, and mail them to USATSA, Fort Lee. Two facilities from Campbell and one each from Hood and Carson were selected. Because there was a question as to whether the data from the four facilities could be pooled and treated as one sample, an analysis of variance was performed to determine if there were significant response differences between posts. Grilled steak was chosen as a target food because of the high response rate.

An initial analysis of variance across the three posts showed one data set from Campbell to have significantly higher mean ratings than the other three data sets. It was eliminated and the data were re-analyzed. The results showed significant differences among the three posts in five of the eight categories with non-significant differences for Appearance, Temperature, and Cook's Preparation. It is possible that the procured items varied at these posts, thus causing a difference, or that preparation differed. Although all foods and posts being tested by USATSA have not been analyzed for potential pooling, these results suggest that pooling would be unwise. In order to pool data with confidence, the experimenter must be certain that variables such as food quality, food preparation and motivational set of the subjects are constant at all test sites. Comments written on some rating cards suggested that strict experimental procedures had not been followed. It is impossible to tell what effect this deviation may have had on the food ratings. It is also important to know if the test food were the only choice on the serving line or if it were paired with an alternative food of the same class (e.g., entree). If subjects selected an item because it was the only choice their attitudes may be different from those who had a choice of several items. Pooling would be advisable only if the experimenter had control over all extraneous variables.

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SYNOPSIS: *Statistical analyses of data from three bases suggest that pooling data would be inappropriate.*

NARADCOM Data

Four new rating card forms were developed for comparison with the USATSA form (See Appendix A, Figures 2, 3, 4, & 5). Card #2 contains a single 7-point hedonic rating scale and a question asking if the subject selected the item. This extremely simple format was chosen to provide a basis for comparison with the more complex forms. If the complex forms did not provide additional information, then the simpler card would be preferable. The verbal anchors on the 7-point scale were carefully selected according to the guidelines given by Jones, Peryam and Thurstone (1955)[2], who showed that 'good' and 'bad' are well balanced around the mid-point 'neutral'. In addition, a space was left on the card titled 'comments'. It was felt that subjects might comment on technical aspects of the food which had contributed to their hedonic evaluations. A large number of comments would be viewed as indicating that the single response scale provided inadequate opportunity for the respondents to report their feelings.

Cards 3, 4, & 5 contain basically the same food quality evaluative questions (Temperature, Flavor, Portion Size, and Texture), the same selection question, and the same 5-point overall hedonic evaluation. Cards #3 and #4 differ only slightly. Card #3 has two additional questions which were taken from the USATSA form (Do you normally like this item? Do you like to here often?). These questions were included for the purpose of comparing the data gathered with this new card and the USATSA card. Card #5 has seven verbal anchors in the food quality categories, rather than the five on cards 3 and 4. Statistically, a seven-point scale is preferable for data analysis because the scale allows greater separation of ratings. There was some question, however, as to whether the average subject could properly discriminate across the levels of a seven-point scale.

The choice of the category labels (temperature, etc.) was made after lengthy consultation with psychologists and food technologists at NARADCOM. The flavor and texture categories were intended to evaluate food quality aspects of the item, whereas the temperature and portion size categories were directed at the food preparation aspects. For the purpose of this test, the verbal modifiers used for the flavor and texture categories were good/bad. It is clearly preferable to tailor these terms to the individual food being

[2]Jones, L. V., D. R. Peryam, and L. L. Thurstone. **Food Research,** 20(5): 512–520, (1955).

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tested (such as tough/tender for meat) but none of these terms is appropriate for all the foods. The verbal modifiers used for temperature (hot/cold) and portion size (big/small) were chosen to convey more information than simply a good/bad statement. The five-point overall hedonic question which appeared on Cards 3, 4, & 5 was formulated using the guidelines mentioned earlier (Jones, et al, 1955). Comment sections were available on Cards 3, 4, & 5 as they were on Cards 1 & 2.

The five rating cards were tested at the Natick Headquarters Company dining facility. Two foods were chosen for intentional adulteration to determine whether this would be reported on the cards. Chicken soup was served at 100°F (instead of 180°F) and white cake was served in 2 inch squares (instead of 3 inch squares recommended by the Armed Forces recipe card). It was felt that these differences would be sufficient to produce lowered ratings in the categories labelled Temperature and Portion Size. The cards were handed out to volunteers, and since the normal attendance at this small facility is quite low, total numbers of useable cards were small (from three to 23). A definitive analysis with such small numbers is not possible. It was evident, however, that respondents were capable of reacting to the intentional adulteration by marking the appropriate categories (Temperature, and Portion Size) lower. In addition to the lower mean ratings, numerous written comments were elicited. Of the five card forms, Card #2 (7-point hedonic) had the largest percentage of food-related comments (50%). Apparently, the card did not allow the respondents adequate expression without additional comments. Many of the comments were directly related to the adulteration which had taken place. It is interesting to note that the other card forms, which allowed expression of attitudes toward more specific food qualities, also elicited comments. Some comments were related to qualities not being evaluated (sweetness of the cake frosting), and others related to the adulteration (too cold, too small).

SYNOPSIS: Four new rating cards were developed and pilot-tested at NARADCOM. The limited data suggested that further testing at Fort Lee was warranted. A simple hedonic card (#2) appeared to contain insufficient information, and cards with both 5-point and 7-point scales appeared to perform adequately.

Initial Testing of NARADCOM Cards at Fort Lee

The four rating card forms which were developed and tested at NARADCOM and the USATSA card were brought to Fort Lee for further testing. Two consolidated dining facilities were chosen for 5-day continuous testing. In one facility hamburgers were rated every day at lunch, and in the other, mashed potatoes were evaluated. No intentional adulterations were made to either food.

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Although the numbers of both hamburger ratings and mashed potato ratings were small, it was reasonable to perform commonality analyses (a special case of step-wise multiple regression, see Appendix C). The results of the analysis of mashed potato ratings and hamburger ratings were used as cross-validations. That is, conclusions were drawn about the performance of a rating card form if the analysis of that card on both mashed potatoes and hamburger were in agreement. It was not possible to perform this analysis on Card Form 2 because it rated only one attribute.

The results of the correctional analyses and visual inspection favor neither Card Form 1 nor Card Form 2. These cards represent the extremes in terms of number of attributes to be rated (see Appendix A). Card 1 (the USATSA card) requires the subject to rate the food item on 8 attributes, some of which are abstract. There is reason to believe that many subjects find this large number of ratings to be confusing. In support of this, the data again showed generalized responses, that is, giving very similar responses to all questions without regard for the specific information requested-a "halo" effect. There were high correlations between ratings of attributes which are logically unrelated, such as that between Portion Size and Flavor or Texture and Serving Temperature.

Card Form 2, which requires the subject to merely give an overall hedonic rating of the food item is not satisfactory because many subjects made comments in areas of food quality which appear on the other four cards. This indicates the need to provide subjects with the opportunity to rate food items in terms of temperature, flavor, portion size, and texture, as well as in terms of their overall rating.

The results of the analysis of Card Forms 3, 4, and 5 were very similar (see Appendices B and C). Thus far, analyses indicated that all three were quite sensitive in measuring attitudes toward food items. Correlations between such logically unrelated attributes as Flavor and Portion Size were low, and correlations between such logically related attributes as Flavor and Texture were moderately high (see Appendix B). Commonality analysis revealed that individual attribute ratings on Cards 3, 4, and 5 manifested more unique variation than individual attribute ratings on Card 1 (see Appendix C).

A comparison of questions 2 and 3 on the USATSA card with the same questions on NARADCOM Card #3 revealed that the patterns of responding to these questions were essentially the same, i.e. the difference in format on Card #3 did not cause a change in response to questions 2 and 3.

SYNOPSIS: *The analyses favored neither Rating Card 1 nor 2. The performance of Cards 3, 4, and 5 was approximately equal, but better than forms 1 & 2, in yielding lower correlations between logically unrelated categories. Following the comparative analysis of Cards 1 and 3, it was determined that Card 3 will no longer be needed for data collection.*

Final Testing of NARADCOM Cards at Fort Lee

For the final evaluation of the rating cards, Card Form 3 was eliminated. It was nearly identical to Card Form 4, excepting the two additional behavior/attitude questions (earlier deemed superfluous). The use of only four card forms instead of five was expected to yield larger samples of people completing each card form, thus yielding more stable statistical results.

The results of commonality analyses were the same as the previous survey. The responses to the different food attributes as measured by Card 1 were highly correlated (see Appendix B). Attributes which were logically unrelated proved to be as highly correlated as attributes which were logically related. Very little unique variation was exhibited by any ratings and an enormous amount of all-rating overlap variation existed (see Appendix C).

Cards 4 and 5, however, exhibited the desirable characteristics of a questionnaire. The food attribute ratings all had relatively large amounts of unique variation. There was some overlapping among attributes which were logically related and minimal overlap variation among logically unrelated attributes (see Appendix C).

Because all cards were used to evaluate the same food, it was expected that the mean rating of an attribute as measured by one card form should be the same as the mean rating of that attribute as measured by the other card forms. It was also of interest to determine if ratings differed either by dining hall or by method of collection (picked up or handed in). Three-way ANOVAS were performed on each food attribute rating.

Neither card type, dining hall, nor method of card collection produced a significant difference on Temperature, Texture, Flavor, or Overall ratings. There was, however, a significant card by collection method interaction.* Follow-up analyses yielded inconclusive results. While it was determined that people completing Card #5 and not bothering to hand it in were more sensitive to the small size of the cake, this finding was not considered practically important.

Because there was an attempt to make the Portion Size attribute of white cake inferior to the Temperature, Flavor, and Texture attributes, it was expected that if the cards were sensitive to the size reduction, an ANOVA performed on those four attributes with additional factors of dining hall, method of collection, and card type would yield a significant difference in attribute ratings. Although dining hall and method of collection

*Analysis of Variance: $\underline{F}$ (3, 140) = 3.18, P<.05

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showed no interaction, the card which had individual food attribute rating categories (1, 4, & 5) did show significant differences as expected.*

A planned comparison revealed that Portion Size ratings were significantly less favorable than Temperature, Flavor, and Texture ratings across all cards. This indicates that Cards 1, 4, and 5 are all sensitive to the small size of the cakes. This is a measure of validity for all of these cards.

It can be drawn from these analyses that method of card collection does not influence food ratings, nor does dining hall, as long as the food was the same in both dining halls, as the white cake was in this experiment.

SYNOPSIS: The results of the white cake experiment tended to underline the conclusion drawn from the analysis of the hamburger and mashed potato data collected at Fort Lee in December 1975. Cards 1 and 2, the most extensive and the least extensive card forms, respectively, proved to be less desirable than Cards 4 and 5. Card 2 does not give enough information, and the attribute ratings of Card 1 do not demonstrate enough independence. Cards 4 and 5 again appear to be equally sensitive. Because they do appear to be equally useful, Card 5 is recommended. Card 5 allows the respondents to select from seven categories when rating each attribute as opposed to the five categories Card 4 allows. The use of Card 5 will allow the respondents to give more precise ratings of the foods.

Statistical Analysis of Additional Fort Lee Data — Beef Roast

USATSA had previously evaluated two grades of beef roast, choice and good. The data were collected at Fort Lee using Card 1. These data provided a good opportunity for additional evaluation of Card 1 regarding its sensitivity to grades of beef. Ideally the "good" grade of beef would perform less well on the food quality attributes such as Tenderness or Juiciness, but about the same on attributes such as Serving Temperature or Portion Size which have nothing to do with the grade of beef.

All subjects who stated they had selected the item were considered eligible for the analysis, regardless of their usual like/dislike of the food, or their customary use of the dining facility (behavior/attitude questions 2 and 3). Because the number of subjects in the two groups of data was so different ("good" =73 and "choice" =662), a random sample was taken from the "choice" group for the analysis of variance, resulting in an $\underline{N}$ of 92. It is necessary to make the number of observations in each group approximately equal to avoid violating the independence of samples assumption of the analysis of variance model.

*Analysis of Variance: $F_{(3, 562)} = 7.53$, $P < .05$.

The results of the ANOVA failed to show any statistically significant differences between the two grades of beef on any of the eight food attribute categories. It may be concluded that for these respondents and beef roasts, Card 1 cannot distinguish between good and choice quality beef.

SYNOPSIS: Card Form 1 did not distinguish between good and choice quality beef roasts in a test using 165 subjects at Fort Lee.

CONCLUSIONS AND RECOMMENDATIONS

1. Asking respondents on a food acceptance rating card to indicate whether they normally like the item is both unnecessary and redundant. All persons eating an item are entitled to an opinion, even though those normally liking the item generally give higher ratings. It is recommended that this question be deleted.

2. Asking respondents on a food acceptance rating card whether they like to eat in the dining hall is unnecessary and yields data which is difficult to interpret. Deletion is recommended.

3. The food acceptance rating card with eight rating scales yields too little independence of different scales. A hypothesis which may fit most of the data is that respondents are 'straight-lining', i.e., marking every column at the same level without property reading each scale separately. This yields high correlations between all pairs of scales whether logically related or not; therefore this card form is not recommended. A form which randomly reverses the evaluative polarity of the scales would inhibit 'straight-lining'.

4. A food acceptance rating card composed of a simple hedonic scale elicits a large number of written comments which would be measured by the scales on the other more complex card forms. It is recommended that this card (Card #2) not be adopted.

5. Both the card with eight scales and the cards with four scales show sensitivity when a food is intentionally adulterated on one response scale (small white cake study). This is interpreted to mean that these cards are valid measures of real differences in foods. The eight scale card is somewhat suspect, however, because adulteration of a food is evidenced in all eight categories to some degree, as was observed in the small white cake and roast beef studies. Further investigation comparing all card forms is warranted.

6. The 7-point scales perform as well as the 5-point scales. Therefore, the 7-point scale is preferable because it will yield more information.

7. Therefore, because of (a) the lack of independence of the food rating categories on the eight category card, (b) the validity of Cards 1, 4, and 5, and (c) the statistical advantages of Card 5, (4 category, 7-point scale), Rating Card #5 is recommended for further use.

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8.   At this time it is appropriate to recommend development of standardized procedures for *administration, analysis, and quality control* with the recommended card. Our finding that cards picked up in the dining hall do not differ from those handed in suggests a practical way in which to increase sample size.

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2.   Jones, L. V., D. R. Peryam, and L. L. Thurstone. *Food Research*, 20(5): 512–520, (1955).

APPENDIX A

APPENDIX A

Food Rating — Feedback Cards

| DID YOU SELECT WHITE CAKE? | ☐ YES ☐ NO | DO YOU NORMALLY LIKE THIS ITEM? | ☐ YES ☐ NO | DO YOU LIKE TO EAT HERE OFTEN? | ☐ YES ☐ NO | CARD C |

RATE FOR →	APPEARANCE ON YOUR PLATE	SERVING TEMPERATURE	TEXTURE	FLAVOR	MOISTNESS	COOK'S PREPARATION OF ITEM	PORTION SIZE	GOES WITH THE REST OF YOUR MEAL
GOOD	☐	☐	☐	☐	☐	☐	☐	☐
SOMEWHAT GOOD	☐	☐	☐	☐	☐	☐	☐	☐
MEDIUM	☐	☐	☐	☐	☐	☐	☐	☐
SOMEWHAT BAD	☐	☐	☐	☐	☐	☐	☐	☐
BAD	☐	☐	☐	☐	☐	☐	☐	☐

PLEASE COMMENT HERE:

TSA Form 60AA 8 JUN 74

FIGURE A-1 ORIGINAL TSA/FORT LEE RATING CARD CONTAINING 8 RATING ATTRIBUTES

DID YOU SELECT ___WHITE CAKE___ ? ☐ YES (continue answering) ☐ NO (STOP & return card) C

After you have tasted the ___WHITE CAKE___, please rate it by marking a box on the scale below.

Very Good	Good	Slightly Good	Neutral	Slightly Bad	Bad	Very Bad
☐	☐	☐	☐	☐	☐	☐

COMMENTS:

TSA Form 67B 30 Oct 75

FIGURE A-2 NARADCOM CARD #2 SIMPLE 7-POINT HEDONIC SCALE

DID YOU SELECT ___WHITE CAKE___ ? ☐ YES (continue answering) ☐ NO (STOP & return card) C

DO YOU NORMALLY LIKE THIS ITEM? ☐ YES ☐ NO   DO YOU LIKE TO EAT HERE OFTEN? ☐ YES ☐ NO

After you have tasted the ___WHITE CAKE___, please rate it for each of the following characteristics by checking one box in each category.

Temperature	Flavor	Portion Size	Texture
Too Hot ☐	Good Flavor ☐	Too Big ☐	Bad Texture ☐
Slightly Too Hot ☐	Slightly Good Flavor ☐	Slightly Too Big ☐	Slightly Bad Texture ☐
Just Right ☐	Neutral Flavor ☐	Just Right ☐	Neutral Texture ☐
Slightly Too Cold ☐	Slightly Bad Flavor ☐	Slightly Too Small ☐	Slightly Good Texture ☐
Too Cold ☐	Bad Flavor ☐	Too Small ☐	Good Texture ☐

Considering everything, how was the ___WHITE CAKE___ ?

Good ☐   Slightly Good ☐   Neutral ☐   Slightly Bad ☐   Bad ☐

COMMENTS:

TSA Form 93B 30 Oct 75

FIGURE A-3 NARADCOM CARD #3; 5-POINT SCALE, FOUR CATEGORY CARD WITH BEHAVIORAL/ATTITUDE QUESTIONS.

DID YOU SELECT _WHITE CAKE_____? ☐ YES (continue answering) **C**
☐ NO (STOP & return card)

After you have tasted the _WHITE CAKE_____, please rate it for each of the following characteristics by checking one box in each category.

TSA Form 93B¹ 30 Oct 75

Temperature	Flavor	Portion Size	Texture
Too Hot ☐	Good Flavor ☐	Too Big ☐	Bad Texture ☐
Slightly Too Hot ☐	Slightly Good Flavor ☐	Slightly Too Big ☐	Slightly Bad Texture ☐
Just Right ☐	Neutral Flavor ☐	Just Right ☐	Neutral Texture ☐
Slightly Too Cold ☐	Slightly Bad Flavor ☐	Slightly Too Small ☐	Slightly Good Texture ☐
Too Cold ☐	Bad Flavor ☐	Too Small ☐	Good Texture ☐

Considering everything, how was the _WHITE CAKE_____?

Good ☐   Slightly Good ☐   Neutral ☐   Slightly Bad ☐   Bad ☐

COMMENTS:

FIGURE A-4 NARADCOM CARD #4 5-POINT SCALE, FOUR CATEGORY CARD

DID YOU SELECT _WHITE CAKE_____? ☐ YES (continue answering) **C**
☐ NO (STOP & return card)

After you have tasted the _WHITE CAKE_____, please rate it for each of the following characteristics by checking one box in each category.

TSA Form 93B² 30 Oct 75

Temperature	Flavor	Portion Size	Texture
Much Too Hot ☐	Very Good Flavor ☐	Much Too Big ☐	Very Bad Texture ☐
Too Hot ☐	Good Flavor ☐	Too Big ☐	Bad Texture ☐
Slightly Too Hot ☐	Slightly Good Flavor ☐	Slightly Too Big ☐	Slightly Bad Texture ☐
Just Right ☐	Neutral Flavor ☐	Just Right ☐	Neutral Texture ☐
Slightly Too Cold ☐	Slightly Bad Flavor ☐	Slightly Too Small ☐	Slightly Good Texture ☐
Too Cold ☐	Bad Flavor ☐	Too Small ☐	Good Texture ☐
Much Too Cold ☐	Very Bad Flavor ☐	Much Too Small ☐	Very Good Texture ☐

Considering everything, how was the _WHITE CAKE_____?

Good ☐   Slightly Good ☐   Neutral ☐   Slightly Bad ☐   Bad ☐

COMMENTS:

FIGURE A-5 NARADCOM CARD #5 7-POINT SCALE, FOUR CATEGORY CARD

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APPENDIX B

APPENDIX B

Descriptive Statistics on Food Ratings

I. Means and Standard Deviations

B—1 — Mashed Potatoes
B—2 — Hamburger Patties
B—3 — Small White Cake

II. Rating Intercorrelation

B—4 — Correlation Matrices for Rating Card 1; Mashed Potatoes and Hamburger Data

B—5 — Correlation Matrices for Rating Card 3; Mashed Potatoes and Hamburger Data

B—6 — Correlation Matrices for Rating Card 4; Mashed Potatoes and Hamburger Data

B—7 — Correlation Matrices for Rating Card 5; Mashed Potatoes and Hamburger Data

B—8 — Correlation Matrix for Rating Card 1; Small White Cake Data

B—9 — Correlation Matrices for Rating Cards 4 and 5; Small White Cake Data

TABLE B–1

DESCRIPTIVE STATISTICS ON RATINGS GIVEN TO MASHED POTATOES

Attributes	Card 1			Card 2			Card 3			Card 4			Card 5		
	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N
Normally like	1.05	0.23	19				1.18	0.39	17						
Like to eat here	1.06	0.23	20				1.23	0.44	13						
Appearance	4.55	0.96	24												
Temperature	4.27	0.98	25				4.45	1.10	22	3.93	1.36	30	5.94*	1.44	32
Texture	4.09	1.15	24				3.70	1.26	23	3.57	1.43	30	4.33*	1.76	33
Flavor	4.14	1.12	23				3.87	1.32	23	3.48	1.50	31	4.82*	1.69	33
Moisture	3.68	1.24	24												
Cook's Preparation	4.14	1.08	25												
Portion size	4.14	1.08	25				4.30	1.29	23	2.93	1.73	29	5.81*	2.26	33
Goes with meal	4.50	0.96	24												
Overall				4.70*	2.25	20	4.22	1.24	23	3.71	1.49	31	3.72	1.37	32

* Responses to this question range from 1 (very bad) to 4 (neutral) to 7 (very good).
Responses to all other questions range from 1 (very bad) to 3 (neutral) to 5 (very good).

TABLE B–2

DESCRIPTIVE STATISTICS ON RATINGS GIVEN TO HAMBURGER PATTIES

Attributes	Card 1			Card 2			Card 3			Card 4			Card 5		
	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	N
Normally like	1.05	0.05	19				1.11	0.32	18						
Like to eat here	1.06	.06	18				1.17	0.38	18						
Appearance	4.55	0.93	22												
Temperature	4.27	0.97	22				4.41	1.18	17	4.19	1.38	27	6.33*	1.27	24
Texture	4.09	1.32	22				4.00	1.00	17	3.81	1.47	27	5.04*	1.55	23
Flavor	4.13	1.27	22				3.71	1.16	17	4.00	1.33	27	5.64*	1.22	22
Moisture	3.68	1.56	22												
Cook's preparation	4.14	1.17	22												
Portion size	4.14	1.17	22				3.11	1.80	17	4.19	1.49	27	5.75*	1.75	24
Goes with meal	4.50	0.93	22												
Overall				5.50*	1.76	18	4.24	1.5	17	3.92	1.38	24	4.27	1.08	22

*Responses to this question range from 1 (very bad) to 4 (neutral) to 7 (very good)
Responses to all other questions range from 1 (very bad) to 3 (neutral) to 5 (very good).

TABLE B-3

DESCRIPTIVE STATISTICS ON RATINGS GIVEN TO
SMALL WHITE CAKE – COLLECTED FEB 1976 AT FORT LEE

Attributes	Card 1 Mean	Std Dev	N	Card 2 Mean	Std Dev	N	Card 4 Mean	Std Dev	N	Card 5 Mean	Std Dev	N
Normally like	1.33	0.47	40									
Like to eat here	1.33	0.47	40									
Appearance	4.04	1.21	49									
Temperature	3.93	1.30	44				4.04	1.32	56	5.37*	2.28	43
Texture	3.69	1.47	45				3.32	1.41	59	4.41*	1.82	44
Flavor	3.82	1.51	45				3.69	1.34	59	5.15*	1.69	48
Moisture	3.57	1.52	44									
Cook's preparation	3.93	1.44	43									
Portion size	3.07	1.68	44				2.62	1.61	58	3.09*	2.04	47
Goes with meal	3.95	1.48	42									
Overall				5.12*	1.94	49	3.86	1.29	56	3.84	1.27	43

*Responses to this question range from 1 (very bad) to 4 (neutral) to 7 (very good).
Responses to all other questions range from 1 (very bad) to 3 (neutral) to 5 (very good).

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TABLE B—4

CORRELATION MATRICES FOR RATING CARD 1; MASHED POTATOES AND HAMBURGER DATA

Mashed Potatoes — Card 1

Variable	Correlation Matrix									
	1	2	3	4	5	6	7	8	9	10
1 Like	1.0000	.1359	.1450	.0171	.0000	.0000	-.1423	-.5533	-.0933	.1685
2 Eat here	.1359	1.0000	-.6262	-.5967	-.5626	-.5099	-.7553	-.4994	-.4122	-.6029
3 Appearance	.1450	-.6262	1.0000	.7955	.8851	.8382	.6450	.4617	.5107	.7514
4 Temperature	.0171	-.5967	.7955	1.0000	.7133	.8249	.8011	.8059	.5273	.7804
5 Texture	.0000	-.5626	.8851	.7133	1.0000	.8643	.7795	.6396	.5654	.7971
6 Flavor	.0000	-.5099	.8382	.8249	.8643	1.0000	.7017	.7625	.5745	.7668
7 Moisture	-.1423	-.7553	.6450	.8011	.7795	.7017	1.0000	.6482	.5708	.7033
8 Cook's preparation	-.5533	-.4994	.4617	.8059	.6396	.7625	.6482	1.0000	.5589	.6032
9 Portion size	-.0933	-.4122	.5107	.5273	.5654	.5745	.5708	.5589	1.0000	.5950
10 Goes with meal	.1685	-.6029	.7514	.7804	.7971	.7668	.7033	.6032	.5950	1.0000

Hamburger — Card 1

Variable	Correlation Matrix									
	1	2	3	4	5	6	7	8	9	10
1 Like	1.0000	.0000	-.7003	-.1472	-.1074	-.3368	-.1617	-.3508	.2047	.1313
2 Eat here	.0000	1.0000	.1296	-.5115	.1785	-.1059	-.1732	-.3961	-.3473	-.7001
3 Appearance	-.7003	.1296	1.0000	.6897	.5979	.6315	.4284	.6567	.5195	.6161
4 Temperature	-.1472	-.5115	.6897	1.0000	.6073	.7384	.4997	.6784	.7678	.8029
5 Texture	-.1074	.1785	.5879	.6073	1.0000	.8356	.8503	.7160	.7160	.6011
6 Flavor	-.3368	-.1059	.6315	.7384	.8356	1.0000	.8453	.8835	.7661	.6807
7 Moisture	-.1617	-.1732	.4204	.4997	.8503	.8453	1.0000	.8790	.7029	.5736
8 Cook's preparation	-.3508	-.3961	.6567	.6784	.7160	.8835	.8790	1.0000	.7967	.7535
9 Portion size	.2047	-.3473	.5195	.7678	.7160	.7661	.7029	.7967	1.0000	.8448
10 Goes with meal	.1313	-.7001	.6161	.8029	.6011	.6807	.5736	.7535	.8448	1.0000

TABLE B-5

CORRELATION MATRICES FOR RATING CARD 3; MASHED POTATOES AND HAMBURGER DATA

Mashed Potatoes — Card 3

					Correlation Matrix					
Variable	1	2	3	4	5	6	7	8	9	10
1 Normally like	1.0000	−.2000	.2744	.0977	−.0318	.2486	.1330			
2 Eat here	−.2000	1.0000	.3000	−.2865	−.6260	−.3156	−.2287			
3 Temperature	.2774	.3000	1.0000	.3945	.3705	.4980	.5321			
4 Flavor	.0977	−.2865	.3945	1.0000	.5278	.6837	.8155			
5 Size	−.0318	−.6260	.3705	.5278	1.0000	.5335	.5936			
6 Texture	.2488	−.3156	.4980	.6837	.5335	1.0000	.8287			
7 Overall rating	.1330	−.2287	.5321	.8155	.5836	.8287	1.0000			

Hamburger Patty — Card 3

					Correlation Matrix					
Variable	1	2	3	4	5	6	7	8	9	10
1 Normally like	1.0000	.7906	.1289	−.6011	−.3034	−.5154	−.7333			
2 Eat here	.7906	1.0000	.1883	−.5535	−.2339	−.1882	−.5138			
3 Temperature	.1289	.1883	1.0000	.2318	.1530	.4253	.5320			
4 Flavor	−.6011	−.5535	.2318	1.0000	.0775	.7543	.6057			
5 Size	−.3034	−.2339	.1530	.0775	1.0000	.2085	.2747			
6 Texture	−.5154	−.1882	.4253	.7543	.2085	1.0000	.6344			
7 Overall rating	−.7333	−.5138	.5320	.6057	.2747	.6344	1.0000			

TABLE B–6

CORRELATION MATRICES FOR RATING CARD 4; MASHED POTATOES AND HAMBURGER DATA

Mashed Potatoes — Card 4

Variable			Correlation Matrix							
	1	2	3	4	5	6	7	8	9	10
1 Temperature	1.0000	.4895	.3937	.1830	.3945					
2 Flavor	.4895	1.0000	.0928	.7504	.8472					
3 Size	.3937	.0928	1.0000	–.0402	.0364					
4 Texture	.1830	.7504	–.0402	1.0000	.7576					
5 Overall rating	.3945	.8472	.0364	.7576	1.0000					

Hamburger Patty — Card 4

Variable			Correlation Matrix							
	1	2	3	4	5	6	7	8	9	10
1 Temperature	1.0000	.5834	.5577	.3006	.7698					
2 Flavor	.5834	1.0000	.8126	.5907	.8108					
3 Size	.5577	.8126	1.0000	.6296	.7848					
4 Texture	.3006	.5907	.6296	1.0000	.4870					
5 Overall rating	.7698	.8108	.7848	.4870	1.0000					

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TABLE B–7

CORRELATION MATRICES FOR RATING CARD 5; MASHED POTATOES AND HAMBURGER DATA

Mashed Potatoes — Card 5

					Correlation Matrix					
Variable	1	2	3	4	5	6	7	8	9	10
1 Temperature	1.0000	.2313	.1105	.0918	.1414					
2 Flavor	.2313	1.0000	.3541	.6945	.6082					
3 Size	.1105	.3541	1.0000	.3931	.4047					
4 Texture	.0918	.6945	.3931	1.0000	.6968					
5 Overall rating	.1414	.6082	.4047	.6968	1.0000					

Hamburger Patty — Card 5

					Correlation Matrix					
Variable	1	2	3	4	5	6	7	8	9	10
1 Temperature	1.0000	.4578	.2339	.3326	.6170					
2 Flavor	.4578	1.0000	.1659	.1173	.3125					
3 Size	.2339	.1659	1.0000	-.0115	.1529					
4 Texture	.3326	.1173	-.0115	1.0000	.8163					
5 Overall rating	.6170	.3125	.1529	.8163	1.0000					

TABLE B-8

CORRELATION MATRIX FOR RATING CARD 1; SMALL WHITE CAKE DATA

Small White Cake — Card 1

Correlation Matrix

Variable	1	2	3	4	5	6	7	8	9	10
1 Dining hall	1.0000	.4215	-.1234	.0912	.0308	.0839	-.0375	-.1112	.0803	-.1755
2 Collected/handed in	.4215	1.0000	.2213	.0117	.0885	.0742	.0862	.1762	.0666	.0691
3 Normally like item	-.1234	-.2213	1.0000	.2357	-.3282	-.3318	-.3930	-.5337	-.5356	-.4950
4 Usually eat here	.0912	.0117	.2357	1.0000	-.4999	-.4010	-.4112	-.4631	-.5356	-.4547
5 Appearance	.0308	.0885	-.3282	-.4999	1.0000	.7343	.6372	.7303	.7792	.7555
6 Temperature	-.0839	.0742	-.3318	-.4010	.7343	1.0000	.7560	.6980	.6804	.7194
7 Texture	-.0375	.0862	-.3930	-.4112	.6372	.7560	1.0000	.7245	.8435	.7311
8 Flavor	-.1112	.1762	-.5357	-.4631	.7303	.6980	.7245	1.0000	.8554	.9024
9 Moisture	-.0803	.0666	-.5356	-.5356	.7792	.6804	.8435	.8554	1.0000	.7816
10 Cooks preparation	-.1755	.0691	-.4950	-.4547	.7555	.7194	.7311	.9024	.7816	1.0000
11 Size	.1478	.0897	-.4676	-.3794	.6546	.5567	.6884	.6962	.7350	.6160
12 Goes with meal	.0667	.1274	-.2517	-.3597	.7496	.7430	.8397	.7068	.7323	.7303

Small White Cake — Card 1

Correlation Matrix

Variable	11	12
1 Dining hall	.1478	.0667
2 Collected/handed in	.0897	.1274
3 Normally like item	-.4676	-.3517
4 Usually eat here	-.3794	-.3597
5 Appearance	.6546	.7496
6 Temperature	.5567	.7430
7 Texture	.6884	.8397
8 Flavor	.6962	.7068
9 Moisture	.7350	.7323
10 Cooks preparation	.6160	.7303
11 Size	1.0000	.7649
12 Goes with meal	.7649	1.0000

TABLE B-9

CORRELATION MATRICES FOR RATING CARDS 4 and 5; SMALL WHITE CAKE DATA

Small White Cake — Card 4

Variable	1	2	3	4	5	6	7
					Correlation Matrix		
1 Dining hall	1.0000	.3640	.0029	-.0274	-.0986	-.0580	.0405
2 Collected-hand in	.3540	1.0000	-.0127	-.1519	.0513	-.3600	.0523
3 Temperature	.0029	-.0127	1.0000	.4724	.3793	.4165	.8686
4 Flavor	-.0274	-.1519	.4724	1.0000	.2281	.5640	.7628
5 Size	-.0986	.0513	.3793	.2281	1.0000	.2444	.3980
6 Texture	-.0580	-.3600	.4165	.5640	.2444	1.0000	.6149
7 Overall	.0405	.0523	.6686	.7628	.3980	.6149	1.0000

Small White Cake — Card 5

| Variable	1	2	3	4	5	6	7
					Correlation Matrix		
1 Dining hall	1.0000	.1839	.0390	-.0390	.0416	.0380	.2780
2 Collected-handed in	.1839	1.0000	-.1110	-.0236	-.1716	-.0822	-.0586
3 Temperature	.0390	-.1110	1.0000	.3291	.1911	.3710	.3041
4 Flavor	-.0390	-.0236	.3291	1.0000	.3391	.6484	.6942
5 Size	.0416	-.1716	.1911	.3391	1.0000	.4342	.4639
6 Texture	.0380	-.0822	.3710	.6484	.4342	1.0000	.7760
7 Overall	.2780	-.0586	.3041	.6942	.4639	.7760	1.0000

APPENDIX C

Commonality Analysis

Commonality Analysis is a special application of stepwise multiple linear regression. It is a method by which the variation of a criterion variable (such as "flavor" or "overall" rating of a food) can be partitioned into proportions which are uniquely and jointly accounted for by two or more prediction variables (such as ratings of "temperature", "appearance" and "portion size" of a food).

Partitioning of Variance: Special Application of Multiple Regression

Pretend Problem

Want to find the relationship of 2 independent variables to criterion
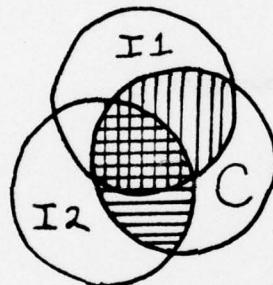
Enables you to divide up the variance of the criterion like a pie
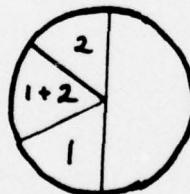
50% of variance of criterion not explained by
   var 1 & 2
20% of variance explained by var 1 uniquely
10% of variance explained by var 2 uniquely
20% of variance explained by var 1 & 2 together
   (because 1 & 2 are correlated)

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Summary of Commonality Analysis

Card 1 — Mashed Potatoes

Analysis 1[*]— Dependent Variable = Flavor

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Appearance Cook's preparation Goes with meal	.0528	.8296	.8824
2. Portion size	.0004	.3297	.3301
3. Moisture	.0214	.4710	.4924
4. Texture	.0221	.7250	.7471
5. Temperature	.0300	.6505	.6805

Summary of Commonality Analysis

Card 1 — Mashed Potatoes

Analysis 2 — Dependent Variable = Flavor

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Cook's preparation Goes with meal	.0427	.6867	.7294
2. Portion size	.0004	.3297	.3301
3. Appearance	.0000	.7026	.7026
4. Texture Moisture	.0254	.7237	.7491
5. Temperature	.0300	.6505	.6805

[*]Two analyses were required to properly evaluate all eight categories.

Summary of Commonality Analysis

Card 1 — Hamburger

Analysis 1 — Dependent Variable = Flavor

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Appearance Cook's preparation Goes with meal	.0075	.7776	.7851
2. Portion size	.0034	.5836	.5870
3. Moisture	.0024	.7122	.7146
4. Texture	.0524	.6459	.6983
5. Temperature	.0358	.5094	.5452

Summary of Commonality Analysis

Card 1 — Hamburger

Analysis 2 — Dependent Variable = Flavor

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Cook's preparation Goes with meal	.0074	.7736	.7810
2. Portion size	.0034	.5836	.5870
3. Appearance	.0005	.3983	.3988
4. Texture Moisture	.0869	.7693	.8562
5. Temperature	.0358	.5094	.5452

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Summary of Commonality Analysis

Card 3 — Mashed Potatoes

Dependent Variable = Overall Rating

Variable	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Temperature	.0051	.2780	.2831
2. Flavor	.0892	.5758	.6650
3. Portion size	.0201	.3323	.3524
4. Texture	.0989	.5879	.6868
5. Normally like Eat here	.0179	.0424	.0603

Summary of Commonality Analysis

Card 3 — Hamburger Patty

Dependent Variable = Overall Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Temperature*	.3248	.0000	.2830
2. Flavor	.0006	.3663	.3669
3. Portion size	.0049	.0706	.0755
4. Texture	.0074	.3951	.4025
5. Normally like* Eat here	.3867	.7760	.5494

*Existence of supressor variable
Refer to Q. McNear, **Psychological Statistics** (4th Ed.), New York: Wiley, 1969, pp 210–211.

Summary of Commonality Analysis

Card 4 — Mashed Potatoes

Dependent Variable = Overall Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Temperature	.0021	.1535	.1556
2. Flavor*	.1104	.6073	.7177
3. Portion size	.0008	.0005	.0013
4. Texture*	.0344	.5395	.5739

*Proportion of "overall" rating variation accounted for by flavor — texture overlap is .4367.

Summary of Commonality Analysis

Card 4 — Hamburger Patty

Dependent Variable = Overall Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Temperature	.1070	.4856	.5926
2. Flavor	.0384	.6190	.6574
3. Portion size	.0229	.5931	.6160
4. Texture	.0003	.2368	.2371

Summary of Commonality Analysis

Card 5 — Mashed Potatoes

Dependent Variable = Overall Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Temperature	.0010	.0190	.0200
2. Flavor*	.0211	.3488	.3699
3. Portion size	.0144	.1494	.1638
4. Texture*	.1204	.3652	.4856

*Proportion of "overall" variation accounted for by flavor — texture overlap is .2166.

Summary of Commonality Analysis

Card 5 — Hamburger Patty

Dependent Variable = Overall Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Temperature	.0787	.3019	.3806
2. Flavor	.0032	.0944	.0976
3. Portion size	.0047	.0187	.0234
4. Texture	.4271	.2392	.6663

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Summary of Commonality Analysis

Card 1 — Small White Cake

Analysis 1 — Dependent Variable = Flavor Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Dining hall Collected-handed in	.0148	.0681	.0729
2. Normally like item Usually eat here	.0023	.4048	.4071
3. Cook's preparation Goes with meal	.1080	.7112	.8192
4. Appearance Portion size	.0184	.5982	.6166
5. Temperature Texture Moisture	.0453	.7173	.7626

Summary of Commonality Analysis

Card 1 — Small White Cake

Analysis 2 — Dependent Variable = Flavor Rating

Variable Set	Proportion of Variation Accounted For		
	Unique	Overlap	Total
1. Appearance	.0001	.5332	.5333
2. Temperature	.0231	.4642	.4873
3. Texture	.0078	.5170	.5248
4. Moisture	.0957	.6360	.7317
5. Portion size	.0090	.4757	.4847

Summary of Commonality Analysis
Card 4 — Small White Cake

Dependent Variable = Overall Rating

	Variable Set	Proportion of Variation Accounted For		
		Unique	Overlap	Total
1.	Temperature	.0891	.3579	.4470
2.	Flavor	.1429	.4389	.5818
3.	Size	.0128	.1456	.1585
4.	Texture	.0210	.3571	.3781

Summary of Commonality Analysis
Card 5 — Small White Cake

Dependent Variable = Overall Rating

	Variable Set	Proportion of Variation Accounted For		
		Unique	Overlap	Total
1.	Temperature	.0003	.0922	.0925
2.	Flavor	.0577	.4242	.4819
3.	Size	.0103	.2049	.2152
4.	Texture	.1114	.4908	.6022